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REMARKS

Applicants thank the Examiner for acknowledging Applicants' claim for priority under U.S.C. § 119 and receipt of the priority document.

Formal drawings for this application, required pursuant to Notice re Patent Drawing, PTO-948 will be timely filed.

I. Formal Matters

The Examiner states that the notation "prior art" is missing from Figures 1-4. In response, Applicants note that Figures 1-4 relate to a general coding system which is used by the present invention. Accordingly, because each of these drawings represents the present invention as well as the prior art, Applicants respectfully submit that it is not appropriate to label these figures "prior art".

The Examiner has objected to Figures 1, 2 and 5 because descriptive labels for the blocks in the figures are missing. Submitted with this Amendment is a Request for Approval of Drawing Changes which would add the required descriptive labels to the drawings.

II. Claim Rejections Under 35 U.S.C. §112, Second Paragraph

Claims 1-8 have been rejected under 35 U.S.C. §112 as being indefinite. The Examiner lists three specific items which he believes make the claims indefinite. In response, claims 1, 5 and 8 are amended.

III. Claim Rejections under 35 U.S.C. §102

Claims 1-8, all of the claims pending in the application, have been rejected under 35 U.S.C. §102(e) as being anticipated by Keith (U.S. Patent No. 5,329,318). In view of the following arguments, the rejection of these claims is respectfully traversed.

The present invention is directed to a system for adaptively variable-length coding and decoding image data. In order to decrease the overall data quantity by removing redundant data contained in a digital video signal, it is known to perform a discrete cosine transform (DCT) coding, differential pulse code modulation (DPCM), vector quantization, and variable-length coding (VLC). After an NxN block shown in Figure 3A is discrete cosine transformed into DCT coefficients of a frequency domain as shown in Figure 3B, the DCT coefficients are quantized and scanned in a zigzag pattern as shown in Figure 3C. When the zigzag scanning is performed, a run, level decoding is simultaneously performed. The result of the run, level decoding is expressed as pairs of run,

level numbers. The first number of the pair signifies the number of zeros between non-zero coefficients according to the zigzag pattern. The second number indicates the non-zero coefficient at the end of the run of zeros.

The run, level data is further compressed using variable-length coding. With reference to Figure 4, a variable-length table is constructed based upon statistical probabilities of the frequencies of occurrence of run, level pairs. In particular, the number of bits which signify particular run, level pairs varies in accordance with the frequency of occurrence of the pairs. For example, a run of zero and a level of one is indicated by two-bits of data, as shown in Figure 4; a run of one and a level of one is indicated by four-bits of data, as shown in Figure 4. An escape region is set aside for run, level pairs which have a low frequency of occurrence. Each run, level pair in the escape region is represented by an escape sequence ESQ. The escape sequence consists of a six-bit escape code ESC, which indicates that the run, level pair is in the escape region, a six-bit run data RUN, an eight-bit level data L, and a one-bit sign data S. Prior art systems utilize one table for variable-length coding data.

The present invention improves on the prior art system by providing a plurality of variable-length coding tables. As shown

in Figures 6A and 6B, one of the plurality of variable-length coding tables is selected based upon the quantization step size Q_{SS} and the scanning position SP. Examples of different variable-length coding tables are shown in Figures 7A to 7C. Since the quantization step size Q_{SS} is transmitted with the data and since the scanning position can be determined from the transmitted data by accumulating the run values, no additional data needs to be transmitted in order to determine the appropriate variable-length coding table to be used during a decoding operation. Providing different variable-length coding tables depending upon the quantization step size Q_{SS} and the scanning position SP allows data to be transmitted using fewer bits than would be possible if just one variable-length coding table were to be used. The reduction in 2. bits is achieved in two ways. First, because the regular region and escape regions of each of the variable-length coding tables are different, the run, level pairs likely to have a high frequency of occurrence according to the specific quantization step size Q_{SS} and scanning position SP, can be assigned designations having a low number of bits. Secondly, the number of bits required to define 3. the escape sequence ESQ can be reduced from the standard 21 bits. This is possible because, for example, as the scanning position SP increases, the maximum value for the run decreases. Therefore, at

the high scanning positions it is not necessary to reserve six-bits to express the value of RUN.

In rejecting the claims, the Examiner states that Keith teaches all of the claimed features. Applicants submit, however, that Keith does not teach or suggest all of the claimed features. In particular, the Examiner refers to column 10, lines 14-40, column 13, lines 34-43, column 14, lines 1-35 of Keith, for disclosing a step of setting a plurality of variable-length coding tables having different patterns of a regular region and an escape region according to statistical characteristics of run, level data.

However, column 10, lines 14-40, describes a process whereby a determination is made whether it is more efficient to estimate the displacement between one frame and the next and transmit only the displacement (that is, motion estimation encoding) or to encode the block based only upon itself (that is, intrablock encoding). Column 13, lines 34-43, of Keith describes decoding data which has been run-length encoded, wherein the decoding restores the original sequence of data by using the same zig-zag pattern to decode the data as was used to encode the data. Column 14, lines 1-35, describes a data structure for storing run/value pairs. Additionally, this portion of the reference describes that block 112a performs a motion estimation process, a variable-length

encoding process and a variable-length decoding process. None of the sections of the reference cited by the Examiner, nor any other section of the reference, teaches or suggests setting a plurality of variable-length coding tables having different patterns of a regular region and an escape region. 4.

In rejecting claims 1 and 5, the Examiner refers to column 10, lines 14-40, column 13, lines 34-43, column 14, lines 1-35, column 8, lines 2-39 and Figures 3A and 3B of Keith as disclosing the claimed feature of selecting one of a plurality of variable-length coding tables according to intra/inter mode information of the currently processed block, zigzag scanning position and quantization step size. With the exception of column 8, lines 2-39, it was explained above that each of the portions of the text referred to by the Examiner does not teach or suggest a
5. plurality of variable-length coding tables. Accordingly, none of these portions of the text teaches or suggests selecting one of a
6. plurality of variable-length coding tables. Furthermore, with regard to column 8, lines 2-39, this portion of the reference describes a process of judging that an intrablock coding should be performed and then dequantizing an inverse discrete cosine transforming a block of data. Reference frame data is then added to the inverse transformed signal and the result is stored in block storage buffer 240. Nothing in this portion of the reference

teaches or suggests selecting <u>one of a plurality</u> of variable-length coding tables.

Regarding Figures 3A, 3B and 6, Figure 3A shows a variable-length encoder 112b, but fails to teach or suggest that variable-length encoder 112b has a plurality of variable-length coding tables. Figure 6 shows a variable-length decoder 112c, but also fails to teach or suggest that the variable-length decoder uses a plurality of variable-length coding tables. Figure 3B does not teach or disclose anything regarding variable-length coding/decoding.

The Examiner refers to Figures 1, 2, 3A, 3B and 6 of Keith, as disclosing the claimed feature of variable-length coding orthogonal transform coefficients according to a selected variable-length coding table. As stated above, Figures 3A, 3B and 6 teach or suggest nothing regarding selecting a variable-length coding table. Figure 1 shows a compression/decompression accelerator 120 which is shown in more detail in Figure 2. Neither of these figures teach or suggest anything regarding variable-length coding/decoding.

Claims 2 and 6 depend respectively from claims 1 and 5 and further define the selection step as having a selection range of a plurality of variable-length coding tables having different

patterns of a regular region and an escape region according to intra/inter mode information. In rejecting these claims, the Examiner states that Keith, at column 10, lines 14-40, column 13, lines 34-43, column 14, lines 1-35, column 8, lines 2-39 and Figures 3A, 3B and 6 disclose this claimed feature. Each of these portions of the reference has been discussed above and each of these portions of the reference does not contain any teaching or suggestion relating to the structure of variable-length coding tables or the provision of a plurality of variable-length coding tables.

Claims 3 and 7 depend respectively from claims 2 and 6 and further define the invention by requiring that the variable-length coding table is selected in accordance with the zigzag scanning position and quantization step size within the range determined by the corresponding mode. The Examiner again cites the previously cited portions of Keith for disclosing these features. However, because none of these sections of the reference discloses a plurality of variable-length coding tables, these portions of the reference do not teach or suggest selecting a variable-length coding table based upon the zigzag scanning position and the quantization step size. Furthermore, Keith does not teach or suggest making any type of selection based upon a zigzag scanning position or a quantization step size. The reference does teach

using the same zigzag scanning pattern to decode the data as was used to encode the data.

Claims 4 and 8 depend respectively from claims 1 and 5 and require that the escape region of the variable-length coding table which is selected in the selecting step is coded into data having variable run-length and level-length. In rejecting these claims, the Examiner states that Figures 2-7 of Keith teach that the data of the escape region of the variable-length coding table is coded into data having variable run-length and level-length. However, except for mentioning that data is variable-length coded and decoded, Keith discloses nothing regarding variable length coding. Keith does not disclose any characteristics of a variable-length coding table, including the escape region of a variable-length coding table. Therefore, this reference does not disclose the characteristics of the data of the escape region of the variable-length coding table, including that the escape region is coded into data having variable run-length and level-length. On the contrary, since the prior art requires a fixed length for all data stored in the escape region of a variable-length coding table, it would seem that this reference would not use variable-length data in the escape region. In any event, there is no teaching or suggestion for this feature.

For all the foregoing reasons, it is respectfully submitted that the claims are patentable and that this application is now in condition for allowance. It is, therefore, respectfully requested that the application be passed to issue at the earliest possible time.

If, for any reason, the Examiner finds this application not to be in condition for allowance, the Examiner is respectfully requested to call the undersigned at the telephone number listed below to discuss any steps which may be necessary to place the application in condition for allowance.

Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

Peter A McKenna

Peter A. McKenna
Reg. No. 38,551

SUGHRUE, MION, ZINN,
MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, D.C. 20037
Phone: (202) 293-7060
FAX: (202) 293-7860
Date: July 24, 1997